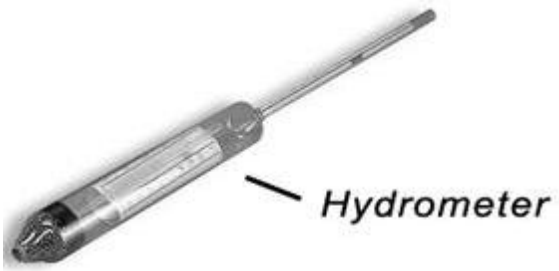
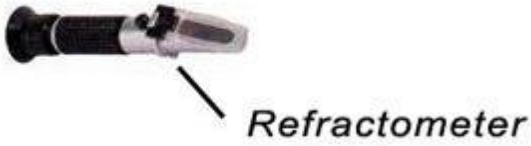
Practical Differences between Refractometers and Hydrometers

In winemaking, for those who do not already know, both Refractometers and Hydrometers are tools used to measure the amount of sugar available for fermentation and to help make indirect projections for potential alcohol. These tools are not used exclusively in winemaking and for intensive purposes arrive at the values that have meaning to winemakers by an indirect method that makes use of time proven assumptions.





The Hydrometer is used to measure the relative density of a solution. That relative density is also known as the Specific Gravity. As a cylindrical stem and mercury weighted bulb that floats in the solution to be measured, the Hydrometer works based upon Archimedes principal that a solid suspended in a liquid will buoyed up by a force equal to the weight of the liquid displaced. Thus, the lower the density of the solution, the lower the Hydrometer will sit [1].

A Refractometer is an optical instrument that employs an entirely different method for identifying an unknown substance, measuring the purity of a particular substance, or in determining the concentration of one substance dissolved in another. It does this by either determining the refractive index of a substance or some physical property of a substance that is directly related to its refractive index. In winemaking the Refractometer is used to measure the concentration of sugar dissolved in water [2].

Temperature

Both the Hydrometer and Refractometer measures are temperature sensitive. For the Hydrometer, the understanding is that density of either the Hydrometer or the solution may change as the temperature changes and so adjustments for variances in temperature from the measuring tool's calibration temperature need to be factored into the results. Similarly, for the Refractometer, as temperature changes, so do refractive indexes and so the need to adjust for temperature changes.

HINT: While use of the Hydrometer requires a handy chart for making temperature adjustments, many Refractometers come with ATC, Automatic Temperature Compensation and so the adjustment is factored into the reading automatically. Consumers should verify that the Refractometer they own or will purchase actually comes with that feature.

Unfermented Juice

Hydrometers and Refractometers can be used interchangeably for the purpose of measuring the concentration of sugar in grape juice. When making the measurement using a Hydrometer, studies show that the Hydrometer has a .4 - .7 degree Brix reading that is higher than actual when the measurement is performed in unfiltered juice [3]. The indication is that Hydrometers are affected by suspended solids and that the readings are more accurate when done in filtered juice [3]. When using a Refractometer, there appears to be less of a dependency on whether the juice is filtered or unfiltered. However, the consensus is that the less particulate, the better. It has been recommended that an "invert sugar" correction factor of

.022 be applied to the Refractometer reading to account for glucose and fructose that is present in the juice. The Refractometer scale is based on a sucrose scale [3].

Juice with Varying Levels of Ethanol

Hydrometers are used in much the same way when measuring remaining sugar in fermenting must or wine as they are use in measuring sugar in unfermented juice. The major difference is that CO2 trapped in solution can collect on the Hydrometer and affect buoyancy. To correct for this, after placing the Hydrometer in the solution to be measured, give it a spin to dislodge any bubbles that may have collected on the bulb or stem. Proceed as normal including the use of temperature corrections.

Research on the use of Refractometers for measuring sugar in fermenting must or wine does show that it could be mathematically possible to apply the correction reading adjustments based upon the current Brix level, the Oringial Brix level, and the estimated % ethanol present in solution. The key issue with the use of Refractometers in fermenting must or wine is that the refractive index changes as ethanol is introduced into the picture. More advanced Refractometer technology might accommodate for that, but it appears that the user would need to instruct the meter to use a different scale. At this point, the use of a Refractometer to easily measure sugar in fermenting must or wine appears prohibitive and especially to the home winemaker who could easily accomplish the same thing with a tool that costs under $20.
If you must measure remaining sugar in fermenting must of wine and insist on not using a Hydrometer, a vinometer could be employed to measure the current alcohol level. From there, a mathematical equation could be applied based off of the orginal Brix translated to potential alcohol less the current alcohol and then converted back to Brix. Here again, the Hydrometer seems a more desirable solution.

Conclusion

While both the Hydrometer and Refractometer can tell winemakers much the same information, there are some practical considerations to be made in employing their use. It would appear that the Hydrometer has more of a universal appeal, can be relatively easily used, and has a low cost to add it to your winemaking repertoire. The Refractometer is a bit more expensive and decent handheld ones for home winemaking use can be purchased for < $100. The Refractometer really shines for use at harvest or at the time of purchase specifically because it requires only a couple of drops of juice, can automatically accommodate for temperature variances (some versions), and can withstand some solid particulate with relative accuracy. In the end, most winemakers come to possess both tools, but for the beginner, the Hydrometer is your most practical purchase of the two.

1. From Wikipedia the Free Encyclopedia. [WWW Document] URL
http://en.wikipedia.org/wiki/Hydrometer

2. From Wikipedia the Free Encyclopedia. [WWW Document] URL
http://en.wikipedia.org/wiki/Refractometer

3. Cooke, G.M. 1964. Effect of grape pulp from soluble solids determinations. Am. J. Enol. Vitic. 15:11-16.